SHILAP Revta. lepid., 43 (171), septiembre 2015: 499-505 eISSN: 2340-4078 ISSN: 0300-5267

First report of the family Urodidae from China, with descriptions of the immature stages of *Wockia magna* Sohn, 2014 (Lepidoptera: Urodoidea)

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Abstract

Urodidae is recorded from China for the first time. The larva and pupa of *Wockia magna* Sohn, 2014 are described. The cocooning behavior of Urodidae is recorded for the first time, and the taxonomic value of the cocoon supporting structure is discussed. Photos of last instar larva, pupa and cocooning process as well as illustrations of setae of last instar larva are provided.
KEY WORDS: Lepidoptera, Urodidae, *Wockia*, immature stage, cocooning behavior, new record, China.

Primera cita de la familia Urodidae de China, con descripción de los estados inmaturos de *Wockia magna* Sohn, 2014 (Lepidoptera: Urodoidea)

Resumen

Urodidae se registra por primera vez para China. Se describe la larva y pupa de *Wockia magna* Sohn, 2014. Se registra por primera vez el desarrollo del capullo de Urodidae y se discute el valor taxonómico de apoyo del capullo. Se proporcionan las fotos de la larva, crisálida y desarrollo del capullo, así como de las setas de las larvas del último estadio.
PALABRAS CLAVE: Lepidoptera, Urodidae, *Wockia*, estados inmaturos, proceso del capullo, nuevo registro, China.

Introduction

Urodidae is a less known family of 74 described species in seven genera. *Wockia* Heinemann, 1870 consists of ten described species: five species are distributed in the Holarctic and Oriental regions and five in the Neotropical Region. The type species, *Wockia asperipunctella* (Bruand, [1851]), is widely distributed in Europe and has been recorded from North America as well.

KYRKI (1984) excluded *Wockia* and its relatives from Yponomeutoidea, but did not assign it to any superfamily. KYRKI (1988) subsequently erected the family Urodidae for *Wockia* and other related genera; NIELSEN (1989) raised this family to a superfamily rank, a classification which is followed in the present paper. However, HEPPNER (1998) assigned Urodidae into the superfamily Sesioidea. Thus, the superfamily assignment of Urodidae remains debatable.

The life history of *Wockia* is poorly known. The immature stages of *W. asperipunctella* and *W. chewbacca* Adamski, 2009 were described by KYRKI (1988) and ADAMSKI *et al*. (2009), respectively. Both species share similar fine mesh cocoons that are supported by silken structures.

However, no literature reveals how the exquisite cocoon is woven, and what the taxonomic value of the cocoon supporting structure is.

In the present paper, we describe for the first time the immature stages of *Wockia magna* Sohn, 2014, which was described by SOHN (2014) based on one male specimen from Japan and one female specimen from Korea. In addition, we record the family Urodidae for the first time in China, report the cocooning behavior of Urodidae for the first time in science, and discuss the taxonomic value of the cocoon supporting structure.

Material and Methods

The pupae of *Wockia magna* were collected and reared in June and August 2013 in Mt. Baxian National Nature Reserves (40º 11' N, 117º 32' E), Tianjin, China. Two larvae were collected in August, 2013 at the same locality (Fig. 1), one of which was reared for pupation to confirm its identity and to record the cocooning process in the laboratory. Numbers of pupae collected on different types of pupation sites were recorded respectively.

Photos of immature stages were taken in the field using a Canon PowerShot G10 digital camera. Line arts were outlined from the photos taken by a Leica M250A stereo microscope, using path tool in Adobe Photoshop® CS4 software. Pupae were studied in detail using a Quanta 200 environmental scanning electron microscope (SEM), coated with gold and operated with a voltage of 10 KV.

Terminology of immature stages follows HINTON (1946) and ZIMMERMAN (1978). Abdominal segments I-X are abbreviated as AI-X.

Descriptions of the immature stages of *Wockia magna* Sohn, 2014

LAST INSTAR LARVA: Length 10.0 mm (Fig. 2a). Head almost square from frontal view; clypeus, frons and adfrontal area black, except frons grayish white posteriorly; epicranium grayish black, with two brownish-yellow streaks on vertex. Body white to grayish white dorsally, except blackish gray on thorax, AV, AVIII, and AX gray laterally; paired blackish-gray dorsal lobes on AV, with D1 setae on top, similar dorsal lobes on AVIII, with D2 setae on top. Crochets uniordinal and in a mesoseries. Spiracles on prothorax and AVIII same size, larger than those on other segments (Fig. 3a).

HEAD: Setae short and thick, almost equal in length except C1and C2 shorter; vertex group absent; F1 at basal 1/3 of frons; AF1 beyond middle of adfrontal area, AF2 at posterior 1/4 of adfrontal area; A1 above base of antennae, A2 dorsal and medial to A1, A3 dorsolateral to A1, ventral to A2; P1 dorsal to A2, slightly medial to A2, P2 dorsolateral to P1; L1 ventrolateral to P2; stemmata 1-5 nearly arranged in a semicircle, stemma 6 posterior to stemma 3; O1 between stemmata 5 and 6, O2 between stemmata 2 and 6, O3 posterodorsal to stemma 1; SO1 ventral to antennal base, SO2 posterior to antennal base, SO3 posterodorsal to SO2 (Figs. 3b-c). Labrum and right mandible shown in Fig. 3d and Fig. 3e, respectively.

PROTHORAX: XD1 anteroventral to D1, longer than and sharing a pinaculum with D1; D2 posterolateral to D1; XD2, SD1, and SD2 sharing a pinaculum, anteroventral to D2; L3 anteroventral to spiracle, L1 ventral to L3, longest, L2 posterior to L1; SV1 posterior to SV2, slightly ventral to SV2 (Fig. 3a).

MESOTHORAX AND METATHORAX: D1 anterodorsal to D2, longer than D2; SD1 anteroventral to SD2, longer than SD2; L1 and L2 on same lobe, anteroventral to L3, L1 longest; SV1 posteroventral to L2 (Fig. 3a).

ABDOMINAL SEGMENTS: AI-II: D1 anterodorsal to D2; SD1 anteroventral to D2, above spiracle; L1 and L2 sharing a pinaculum, equal in length, L2 anterior to L1, L3 posteroventral to L1; SV1 anteroventral to L3. AIII-VI: similar to AII, except L1 posterodorsal to L2; SV1 and SV2 on same lobe, SV2 anteroventral to SV1. AVII: similar to AII. AVIII: D2 posterodorsal to D1, SD1 anterodorsal to spiracle, L1 and L2 sharing a pinaculum, L3 anteroventral to L2 and L1; SV1 posteroventral to L3,

slightly moved dorsally. AIX: D2 posterodorsal to D1; SD1 posteroventral to D1; L1 and L2 on different pinaculums, L1, L3 and SV1 in a line (Fig. 3a).

PUPA: Length 8.7 mm (n = 3). Body ground color yellowish white, with darker blotch patterns varied from pale brown to blackish brown (Fig. 2b). A pair of hooked setae on upper frons, two pairs of such setae slightly behind vertex, five pairs of such setae on AX: one pair near anterior margin dorsally, two pairs before posterior margin dorsally, one pair laterally, one pair in middle ventrally (Figs. 4 and 5a); dorsal spines present on AIV-IX (Figs. 4 and 5b); spiracles protruded on abdominal segments (Fig. 5c). Seta dorsal to spiracle on AII specialized: base cone-shaped with distal part bending forward; a strong seta on top, pointing forward and bending downward distally (Fig. 5d).

HOST PLANT: The last instar larvae were collected from the ground thus with uncertainty of their host plant. The sites where pupae were collected had *Populus davidiana* Dode (Salicaceae) nearby, which might be the host plant of this species since *Wockia* has its host plants within Salicaceae so far (ADAMSKI *et al*., 2009).

NOTES ON COCOON: The fine mesh cocoon opens at both ends of longitudinal axis and stands on the supporting structure attached to the substrate. The supporting structure of *W. magna* usually comprises three curved short silken legs (Fig. 2b). The mesh structure of the cocoon matches the hooked setae on the anterior and posterior end of the pupa. Before eclosion, the pupa hung in the cocoon under the support of the two groups of setae hooked into the meshes of the cocoon (Fig. 2b). The pupa protruded its anterior part out of the cocoon and set the anterior group of setae free during adult eclosion, while the posterior setae were still hooked into the meshes to stabilize the pupa (Fig. 2d). The statistical analysis of pupation sites demonstrated the preferred pupation sites of this species. A total of 34 cocoons were found in the collecting sites. The lower surfaces, such as rocks on the ground and leaves of shrubs, were generally selected as pupation sites with priority. Four types of pupation sites were determined: the upper surface of a leaf, the lower surface of a leaf, a twig, and a rock on the ground. A majority of cocoons were found on the upper surface of a leaf or on a twig (47 and 35%, respectively). A preference for pupation on the upper surface of a leaf to a more hidden lower surface of a leaf was adopted by the species.

COCOONING PROCESS: Cocooning began at midnight after a period of six-hour immobility. Having selected the pupation site, the larva would rapidly hang downward when disturbed (Fig. 6a), and drew back soon. The supporting structure, i. e., the short silken legs, was set up first. Upon the silken legs, cocooning was carried out by the larva weaving each cross-section in a circle from one end to the other along the longitudinal axis (Figs. 6b-d). The whole process lasted for about 1.5 h.

Discussion

The larval characters of *W. magna* agree with the possible autapomorphies for Urodidae given by KYRKI (1988): prolegs long and slender with crochets in a mesoseries, L3 anteroventral to L1 and L2, and SV1 moved dorsally. Although a single MD seta on the metathorax is present in *W. asperipunctella* (KYRKI, 1988) and two MD setae in *W. chewbacca* (ADMSKI *et al*., 2009), no MD seta on the metathorax are recognized in *W. magna.* The specialized seta dorsal to the spiracle on AII is unique for the pupa of *W. magna* as compared to that of *W. asperipunctella* and *W. chewbacca*.

The cocoon of *W. magna* stands on the short silken legs, while *W. chewbacca* has its cocoon supported by a long thread (ADMSKI *et al*., 2009), which resembles that of *Urodus parvula* (Edwards, 1881) (FROST, 1972). The short silken legs probably can exclude *W. chewbacca*, or even its Neotropical relatives from *Wockia*.

A great majority of pupae are protected by some sort of cocoon, or earth cells, as they lose the power of locomotion (MOSHER, 1916). However, a preference for pupation in a conspicuous site is adopted by *W. magna*, and the mesh cocoon makes the inner pupa visible, or even more conspicuous due to its reflection. Further study on the biology of Urodidae is needed to solve the problem of why a preference for pupation in a conspicuous site exists in *W. magna* and/or perhaps in other *Wockia* species, and to test the taxonomic value of the supporting structures of the cocoon.

Acknowledgements

We are indebted to the staff of the Baxian Mountain National Nature Reserves for their kind help and support in the field work. This study is supported in part by the National Natural Science Foundation of China (No. 31272356 and No. J1210005).

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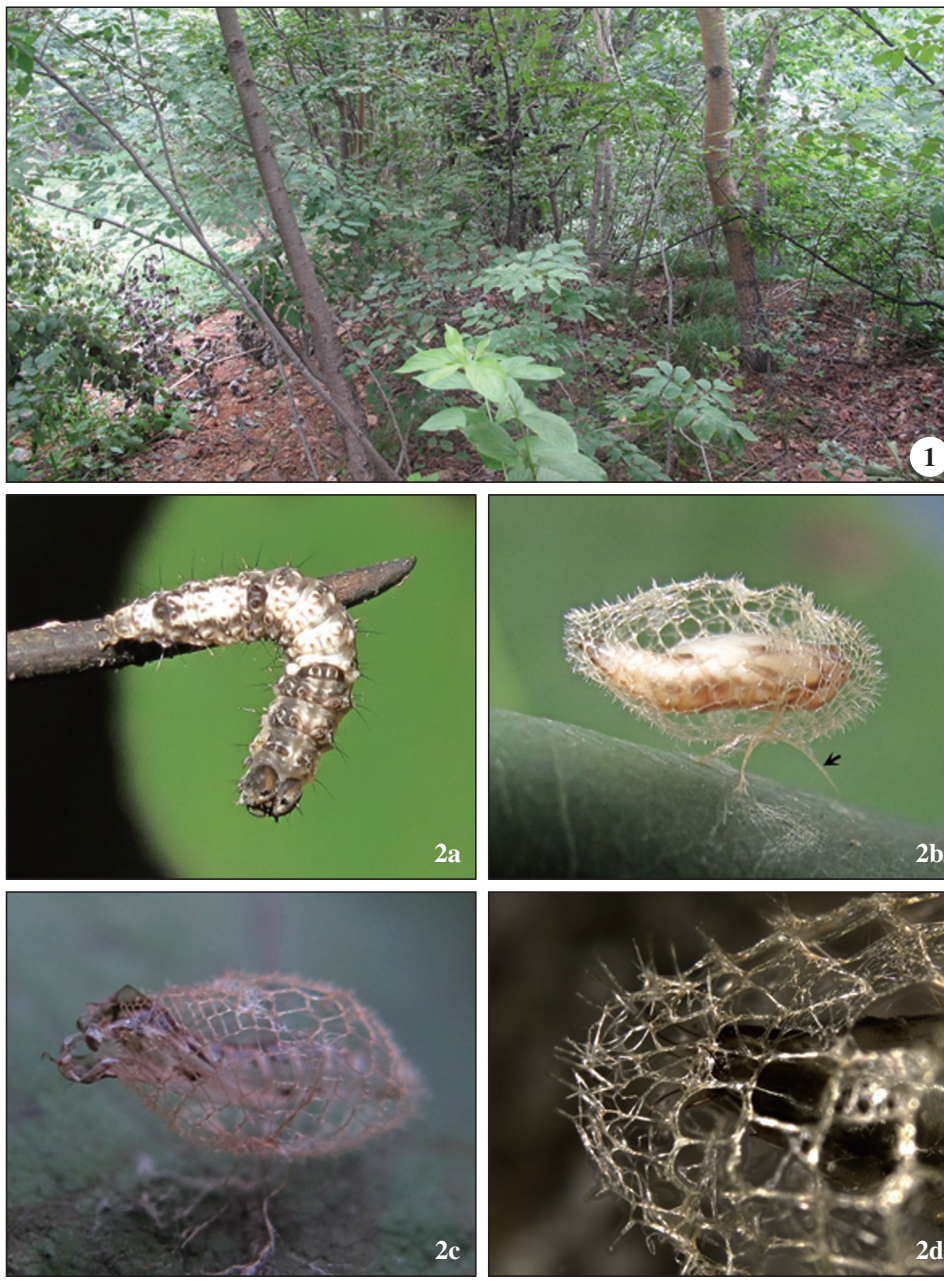
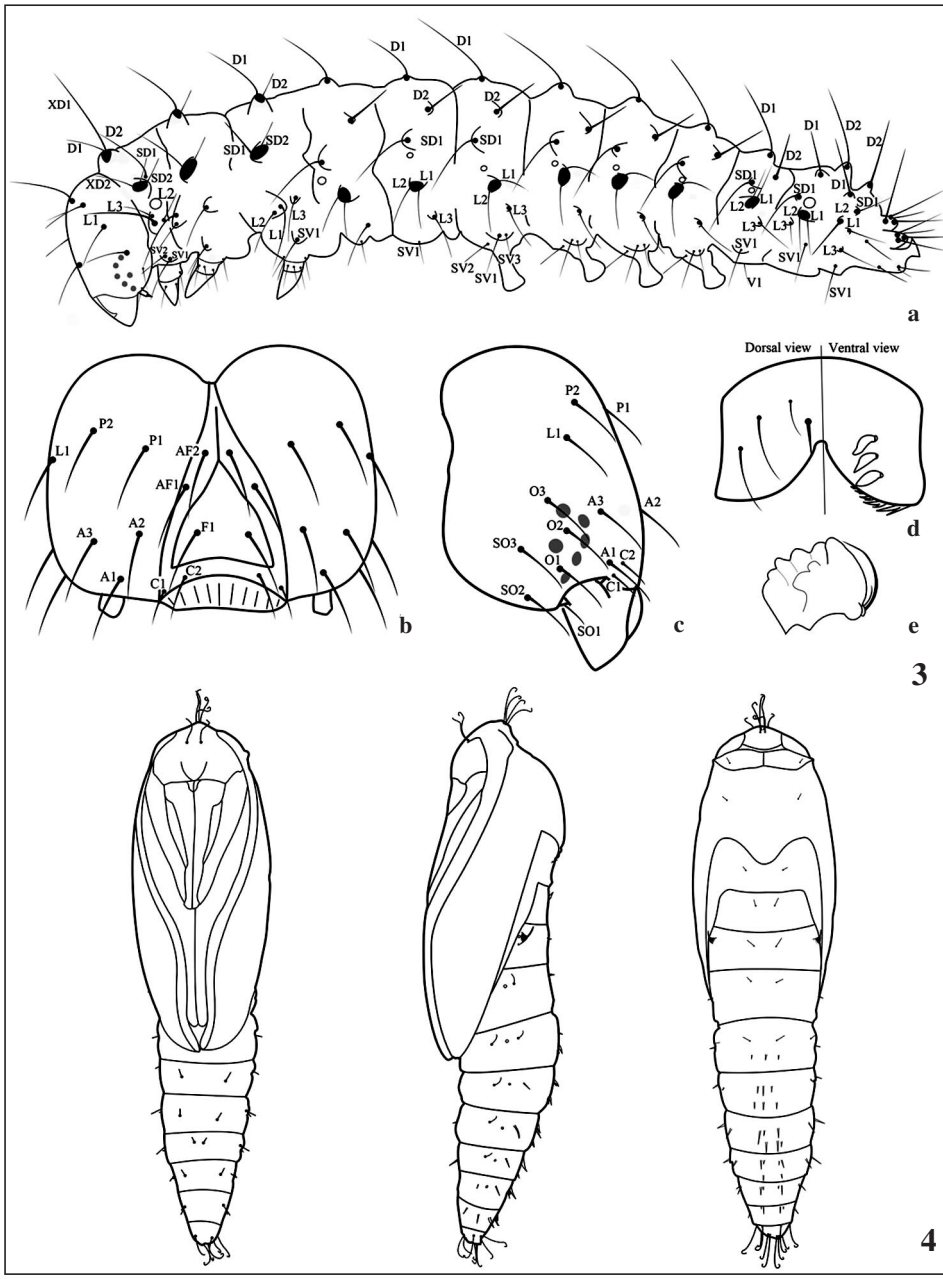
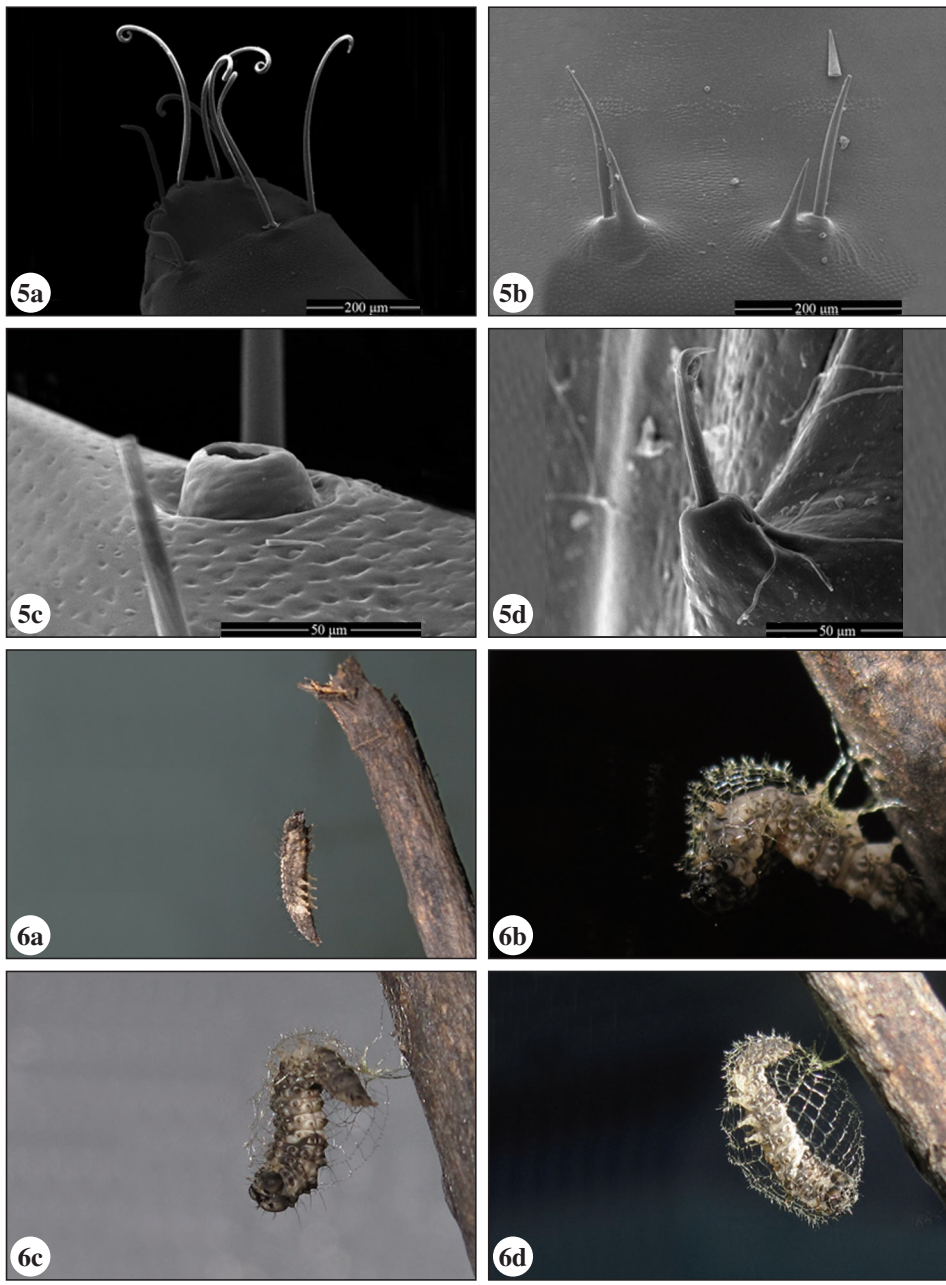
(Recibido para la publicación / *Received for publication* 25-VIII-2014)
(Revisado y aceptado / *Revised and accepted* 23-IX-2014)
(Publicado / *Published* 30-IX-2015)



Figures 1-2.– 1. Collecting site of *Wockia magna* Sohn. **2.** Immature stages of *Wockia magna* Sohn. (**a**) Last instar larva. (**b**) Pupa in cocoon, arrow indicating the cocoon supporting structure. (**c**) Pupal cuticle in cocoon. (**d**) Hooked setae on the posterior end of pupal cuticle indicating how they hook onto the meshes of cocoon.



Figures 3-4.– Line arts of immature stages of *Wockia magna* Sohn. **3.** Setae of last instar larva. (**a**) Body, lateral view. (**b**) Head, frontal view. (**c**) Head, lateral view. (**d**) Labrum, dorsal and ventral view. (**e**) Right mandible, ventral view. **4.** Pupa, ventral, lateral and dorsal view.



Figures 5-6.– 5. SEM photos of pupa of *Wockia magna* Sohn. (**a**) Setae on posterior end of pupa, dorsolateral view. (**b**) Dorsal spines. (**c**) Spiracle on abdomen. (**d**) Specialized seta dorsal to the spiracle on AII. **6. a-d.** Cocooning process of *Wockia magna* Sohn.